Optical Observations of the Dark Gamma-Ray Burst GRB 000210

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Abstract. We report on optical observations on GRB 000210 obtained with the 2.56-m Nordic Optical Telescope and the 1.54-m Danish Telescope starting 12.4 hours after the gamma-ray event. The content of the X-ray error box determined by the Chandra satellite is discussed.

1 Introduction

The BeppoSAX Gamma Ray Burst Monitor and the Wide Field Camera (unit 1) observed a strong gamma-ray burst on 2000 February 10.36396 UT. It exhibited an X-ray flux of 7.4 Crab (2-26 keV) and a duration of $\sim$ 20s [11]. The field was observed by the Chandra X-ray satellite approximately 21 hours after the GRB [3,4] which localised an uncataloged X-ray source to within 2″. The position was consistent with the one derived independently by BATSE, IPN and the Narrow-Field Instruments (NFI) on-board BeppoSAX [9,8,2]. The Chandra position was improved and the X-ray error box reduced to a circle of 1.6″ radius [5]. Optical observations obtained with the 1.54-m Danish Telescope (1.54D) on 2000 Feb. 11.03-11.08 UT ($\sim$ 16 hours after the burst) revealed an object coincident with the X-ray error box determined by Chandra [6]. These optical observations are part of the results reported in this paper. Deep radio follow-up observations starting 14.8 hours after the gamma-ray event, did not find any radio emission associated to the afterglow above 55 microJy [1,10].

2 Observations

We obtained optical observations with the 2.56-m Nordic Optical Telescope (NOT) and the 1.54D starting 12.4 hours and 16 hours after the burst, respectively. The NOT observations were carried out with HIRAC and at the 1.54D with the DFOSC instrument. Table 1 displays the observing log.

Table 1. List of the observations obtained with NOT and 1.54D Telescopes.

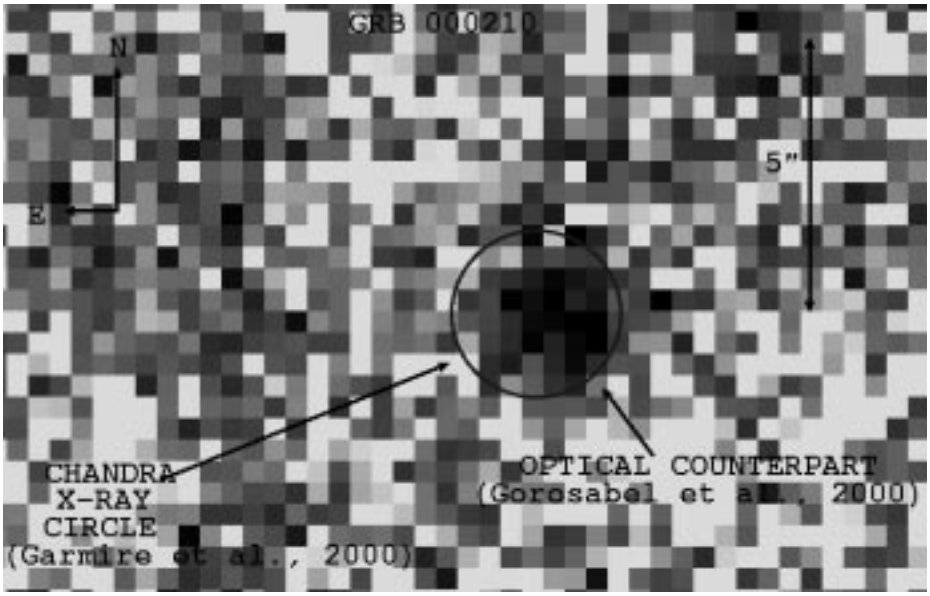
Date 2000(UT)	Filter	Exposure Time	Seeing	Telescope
Feb. 10.88 - 10.90	R	3x300	1.2	NOT
Feb. 11.03 - 11.08	R	10x300	1.6	1.54D
Feb. 14.02 - 14.03	R	600	1.9	1.54D
May 5.42 - 5.44	R	2x600	2.3	1.54D
Aug. 22.29 - 22.41	R	7x900	2.2	1.54D
Aug. 23.23 - 23.29	R	5x900	2.3	1.54D
Aug. 24.23 - 24.30	R	4x900	3.0	1.54D
Aug. 26.29 - 26.43	V	9x900	1.5	1.54D
Aug. 27.21 - 27.24	I	2x900	1.4	1.54D
Aug. 28.21 - 28.24	I	2x1200	1.4	1.54D
Aug. 29.21 - 29.30	I	7x1200	1.1	1.54D
Aug. 30.22 - 30.24	I	1200	1.1	1.54D
Aug. 31.21 - 31.24	B	2x1200	1.5	1.54D

The observations carried out in August improved the previous position reported in February [6], yielding $\alpha_{J2000} = 01^h59^m15.60^s$, $\delta_{J2000} = -40°39'32.8''$ with an uncertainty of $\pm 1''$ [7]. This position is fully consistent with the improved Chandra X-ray circle position [5] (see Fig 1). The first images taken at NOT were not deep enough to detect the object. A comparison of the co-added R-band image taken on Aug 22.29– 24.30 UT with the R-band image taken 16 hours after the burst gives a magnitude difference of 0.03 ± 0.30 mag. Therefore, the object remains constant in brightness within the photometric errors. We derive a magnitude of $R = 23.5 \pm 0.2$ for the object.

3 Conclusion

Although the object is very faint in our images its appearance is not stellar. The photo-profiles shows an object slightly elongated in the North-East direction with an angular extension of $\sim 1.5''$. The angular size in the orthogonal direction (North-West) is limited by the seeing ($1.1''$ in our best images). The object did not change in brightness since the first detection carried out just 16 hours after the burst. GRB 000210 appears to be one of the best candidates to study the problem of the "dark burst", resembling GRB 970828. It would be extremely important to perform deep optical/IR observations aimed to determine the redshift, the spectral energy distribution and the morphology of this enigmatic object.

Fig. 1. The figure shows a blow up of the co-added R-band image taken on Aug 22.29–24.30 UT. The plot shows the position of the improved Chandra X-ray circle [5] and the optical candidate [7].



Acknowledgments

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